

Two new genera of Chalcosiinae (Zygaenidae) from eastern Palaearctic Asia

Shen-Horn YEN¹⁾ and Ping-Shih YANG²⁾

¹⁾ Laboratory of Natural Resource Conservation, Department & Institute of Biological Sciences, National Sun Yat-Sen University, Kaohsiung, Taiwan*

²⁾ Laboratory of Insect Conservation, Department & Institute of Plant Pathology and Entomology, National Taiwan University, Taipei, Taiwan

Abstract On the basis of adult and immature characters, two new chalcosiine genera from eastern Palaearctic Asia are proposed: *Neochalcusia* gen. nov. for *Eterusia remota* Walker, 1854 = *Chalcusia remota* (Walker, 1854), and *Pseudopidorus* for *Aglaope fasciata* Felder & Felder, 1862 = *Pidorus euchromioides* (Walker, 1864). In the preferred cladogram, the *Neochalcusia* + *Pseudopidorus* clade may possibly form a sister-group with the *Chalcusia* + *Milleria* clade. In addition, we also discuss the important morphological characters of the *Chalcusia* genus-complex and the effects of those characters on the taxonomy of the complex.

Key words Zygaenidae, Chalcosiinae, phylogeny, new genus, *Symplocos*, Asia, Japan, Korea, China, Taiwan.

Introduction

While revising the taxonomy of the *Chalcusia* genus-complex, we found that *Chalcusia remota* (Walker, 1854), a well-known species from eastern Palaearctic Asia, is obviously not monophyletic with the type-species group of *Chalcusia*, and that it is phylogenetically similar to another eastern Palaearctic Asian species, *Aglaope fasciata* Felder & Felder, 1862, which has been known as *Pidorus euchromioides* (Walker, 1864). In fact, Jordan (1907a) mentioned the affinity between these two species and the distinct wing markings of *C. remota* from other *Chalcusia* species. Having checked the genitalia of both species and related taxa, we came to the conclusion that it is necessary to propose two new genera for them, viz. *Neochalcusia* gen. nov. for *C. remota* and *Pseudopidorus* gen. nov. for *A. fasciata*. In the following sections, we first describe two new genera, and then we attempt to discuss some morphological characters and elucidate their phylogenetic relationships with the taxa involved. In addition, a discussion on important morphological characters of the *Chalcusia* genus-complex and the effects on the taxonomy of the complex are provided.

Depositories of material examined

The following is a list of abbreviations of the depositories in which the materials examined are preserved.

BMNH : British Museum (Natural History), London, England.

HUFA : Hokkaido University, Faculty of Agriculture, Sapporo, Japan.

RNHL : Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands.

SHYC : S. H. Yen Collection, Taiwan.

* Present address: No. 11, Alley 10, Lane 93, Shin-Nan Rd. Sec. 1, Chung-Ho City, Taipei County, Taiwan.

TLFNI : Tiroler Landesmuseum Ferdinandeum, Naturwissenschaften, Innsbruck, Austria.

Taxonomic accounts

***Neochalcosia* gen. nov.** (Figs 1 : E-H, 2, 3 & 12)

Type species. *Eterusia remota* Walker, 1854, *List Specimens lepid. Insects Colln Br. Mus.* 2 : 431.

Description. A genus of medium-sized chalcosiine species. Head : Frontoclypeus simple, not modified or produced, postocciput developed with a posterior angle. Labial palpus 3 segmented, terminal segment stout. Proboscis length about $3 \times$ diameter of compound eye. Antenna bipectinate; length less than $1/2$ of wing length, female with shorter flagella than male. Chaetosemata restricted on vertex. Thorax : Dark black. Forewing elongated, with discoidal cell about $2/3$ as long as wing length; $R_3 + R_4$ stalked with R_5 ; $(R_3 + R_4) + R_5$ and M_1 arising together from anterior angle of discoidal cell; M_2 and M_3 arising from posterior angle of discoidal cell; CuA_2 emitting from discoidal cell at proximal $3/5$. Hindwing oblong, oblique; frenulum consisting of 1 bristle in male and of 4 in female, male frenulum with apex tapered and flattened; male androconial hair tuft present at base. Abdomen : Tergum black dorsally, white ventrally. Eighth segment of male tinged metallic bluish green, specialized into a genitalia-like complex, tergum with posterior and lateral margin emarginate, posterior margin glabrous beneath; arms of sternum elongated with distal part slightly produced posteriorly, two teeth present on inner margin.

Male genitalia. Uncus broad, stout, sclerotized laterally, 5–6 pairs of long setae present on surface dorsally; gnathos reduced, scaphium membranous with 8–10 pairs of long setae. Tegumen fairly slender, interior extension forming a complex sclerite with juxta; vinculum narrow with saccus less developed. Valva with costal margin plain, membranous and setose, ventral lobe of valva strongly sclerotized with short setae ventrally, distal surface of valval lobe with numerous grooves, process of inner margin produced with apex rounded. Aedeagus curved upwards, apical part with a small hook, medial part swelling, cornutus absent.

Female genitalia. Apophyses anteriores slender, a small tusk-like process present on apophyses anteriores near anterior margin of 8th tergum, apophyses posteriores slender, extending to the 7th tergum. Bursa copulatrix with corpus bursae oblique, appendix bursae absent, signa absent, ductus bursae slender, antrum weakly sclerotized. Ductus seminalis short, branching near corpus bursae. Pseudobursa present, nearly equal to corpus bursae in size. Ductus spiralis and lagena present.

Immature stages. Mature larva colourful, without prominent verrucae as *Chalcosia* and *Milleria*. SD2 and L2 setae present in abdominal segments 1–8.

Diagnosis. Distinguished from the other chalcosiine genera by having male 8th sternite with elongated arms, fairly sclerotized valvae and broader tegumen-juxta complex.

Distribution and diversity. Only one species known from eastern Palaearctic Asia.

Neochalcosia remota (Walker, 1854), **comb. nov.** (Figs 1 : E-H, 2, 3 & 12)

Eterusia remota Walker, 1854, *List. Specimens lepid. Insects Colln Br. Mus.* 2 : 431.

Laurion remota : Butler, 1878, *Illust. typical Specimens Lepid. Heterocera Br. Mus.* 2 : 9, pl. 23, fig. 10; Kirby, 1892, *Syn. Cat. Lepid. Heterocera* 1 : 53.

Chalcosia remota: Jordan, 1907a, in Seitz, *Gross-Schmett. Erde* **2**: 12, pl. 2, fig.; Nagano, 1916, *Bull. Nawa ent. Lab.* **21**: pl. 6, figs 10–11 (larva), pl. 9, fig. 2; Hering, 1922, *Arch. Naturgesch.* **88** (A) (11): 70; Matsumura, 1931, *6,000 Illust. Insects Japan-Empire*: 285, fig. (♀); Wang, 1993, *Guide Book Insects Taiwan* **2**: 35; Wang, 1995, *ibid.* **12**: 60–61.

Adult. Length of forewing: ♂, 25–27 mm, ♀, 25–28 mm. Antennal length 12.1–12.5 mm in male, 12.1–12.3 mm in female; flagellar segments about 85–90. Forewings black with creamy white bands and hindwings with white patches extending from base to post-medial part.

Immature stages. Mature larvae 29.0–30.0 mm in length. Head retractile, prognathous, with primary setae consisting of simple hairs; epicranium with less-developed inverted Y-shaped suture; medial arm of suture about 1/11 of head; antennae prominent; labrum with 3 pairs of major setae dorsally, and 3 pairs of stout setae ventrally as illustrated; mandibles somewhat quadrate, with 5 main apposable teeth on edge; hypopharyngeal complex as illustrated, with spinneret single, and with distal field having a broad spine field laterally each side of the median at the medial transverse cleft; stemmata 6 in number. Thorax and abdomen with primary and sparse subprimary setae and less-developed verrucae.

Pattern and colouration. In mature larvae (6th instar), ground colour uniformly black. D verrucae with quadrate white patches, SD verrucae with arcuate white patches around, L verrucae pink distally, SV verrucae black with small white patches.

Chaetotaxy. Cranial setae: C2 longer than C1; F1 short; AF1 present, AF2 absent; A1 present, A2 absent; V, P and L setae absent. Thoracic setae: Tactile setae XD1 and XD2 of approximately equal length; XD1 dorsal to XD2. D1 and D2 primary on thoracic segments, of approximately equal length. SD verrucae of 2nd thoracic segment with 4 setae. L1 and L2 present on 1st thoracic segment, L2 absent on 2nd and 3rd thoracic segments. SV verrucae absent on thorax. Abdominal setae: From 1st to 8th segment, D verrucae with two setae of equal length, SD verrucae with 2 setae, L verrucae with 3 setae. SV setae present on 1st and 2nd segments. Segment 9 merging with 10, chaetotaxy different from the former segment with D verrucae trisetose, SD verrucae bisetose and L1+L2 verrucae trisetose. Segment 10 with 4 setae on D+SD verrucae, a tuft of PP setae present. Crochets prominent, uniordinal and short.

Openings of chemical secretion: Similar to type I sensu Naumann & Feist (1987: 91, Fig. 10). From 2nd thoracic segment to 8th abdominal segment, a single opening associated with D verrucae, SD verrucae with two openings; L verrucae from 1st to 8th abdominal segments with only one opening.

Pupa. Body 16.0 mm in length, 6.0 mm in width of mesothorax, stout, enclosed in a white cocoon. Head: Frons ellipsoid with a pair of short setae; proboscis extending to hind margin of 5th abdominal segment; antennae reaching middle of abdominal segments 6. Thorax: Prothoracic spiracles concealed; metathoracic legs extending to middle of abdominal segment 7; wing sheaths extending to hind margin of 5th abdominal segment. Abdomen: 10 segmented, spiracles present on segments 3–8; tergites spinulose anteriorly; apex of segment 10 without cremaster.

Geographical distribution. Korea, Japan (Hokkaido, Honshu, Shikoku, Kyushu, Tsushima I.), E., NE. and SW. China and Taiwan (?).

Habitat. According to Nishihara (*pers. comm.*, 1997), the habitat in Aichi Prefecture abounds in *Quercus serrata* and *Q. variabilis*. The species also occurs in parks and small coppices

with rather poor vegetation where deciduous *Symplocos* species grow.

Biology. The species is univoltine. The adult is day-flying and occasionally attracted to light traps, and appears in June to August (Inoue, 1982; Nishihara, *pers. comm.*, 1997). Mature larvae occur from April to June and pupate within a white cocoon in the end of June (Hattori, 1969; Nakajima, 1987). The known hostplants are *Symplocos chinensis* (Lour.) Druce, *S. coreana* (Lév.) Ohwi, *S. paniculata* (Thunb.) Miq. and *S. tanakana* Nakai (Symplocaceae).

Remarks. A male specimen collected from Keelung, a port of NE. Taiwan (collecting data not recorded) is found in BMNH. The specimen was illustrated by Wang (1993, 1995) and regarded as a new addition to the moth fauna of Taiwan. However, after having examined the specimen in BMNH, we consider the locality of the specimen is quite doubtful. Firstly, the insect fauna of NE. Taiwan is chiefly composed of the extreme northeast elements of the S. Chinese lowland and is partly similar to the Yaeyama Islands of Japan, where the species is absent. Secondly, based on the hand-writing on the label, the specimen is likely belonging to the collection of A. E. Wileman, a British diplomat who traveled from Japan to Taiwan in 1902 and stayed in Taiwan for 6 years before he transferred to the Philippines and donated all his collection to BMNH in 1914. We suspect that the specimen might be carried by Wileman himself from Japan to Taiwan because all of his collection from Taiwan was gathered from the south. But why he labelled the specimen "Keelung, Formosa" which he might never reach, is still questionable. Finally, the large day-flying species has never been collected by any insect collector of Japan and Taiwan during the past 1 century although the hostplant *Symplocos chinensis* is abundant in the coastal vegetation of NE. Taiwan. Therefore, Taiwan is only tentatively retained in the distribution of this species in the present study.

***Pseudopidorus* gen. nov.** (Figs 1: A-D, 4 & 12)

Type species. *Aglaope fasciata* Felder & Felder, 1862, *Wien. ent. Monatschr.* 6: 32.

Description. A genus with medium-small sized chalcosiine species. Head: Frontoclypeus produced forwards and elevated, postocciput with a angular process. Proboscis rather short, less than diameter of compound eye. Labial palpus 3 segmented, porrect, short. Antenna bipectinate; length approximately 3/4 of wing length, antennae with elongated scales on each segment, female with shorter flagella than male. Thorax: Dark metallic bluish-green. Forewing elongated; discoidal cell about 3/5 as long as wing length; $R_3 + R_4$ stalked with R_5 ; a short distance present between bases of $(R_3 + R_4) + R_5$ and M_1 ; M_2 and M_3 separate; CuA_2 emitting from discoidal cell at proximal 3/5. Hindwing short, ovate, oblique; frenulum consisting of 1 bristle in male and of 3 in female; male androconial hair tuft present at base, short. Abdomen: Tergum dark bluish-green dorsoventrally, paler laterally. Eighth segment of male specialized into a genitalia-like complex, tergum with posterior and lateral margin emarginate, posterior margin sparsely setose beneath; sternum tusk-like with apex pointed.

Male genitalia. Uncus broad, stout, weakly sclerotized laterally, 4 pairs of long setae present on surface dorsally; gnathos reduced, scaphium membranous with several long setae. Tegumen slender, interior extension forming a complex with juxta; vinculum narrow with a small saccus, extending anteriorly. Valva with costal margin acute, membranous and setose, ventral lobe of valva strongly sclerotized with short setae ventrally, inner margin of valva with several transverse ridges plus a larger distal process medially. Aedeagus curved upwards,

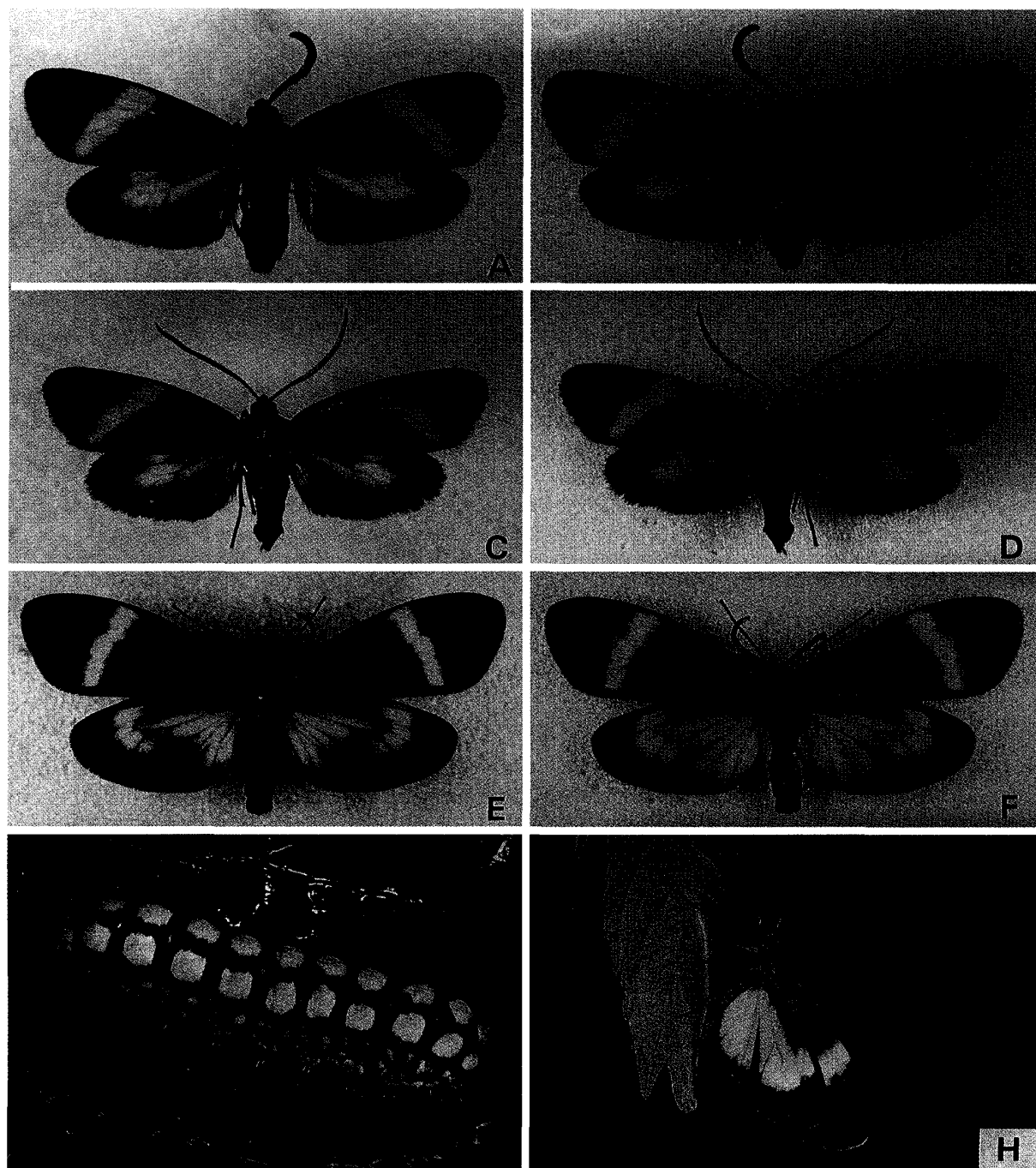


Fig. 1. *Pseudopidorus fasciatus* and *Neochalcusia remota*. A-D. *Pseudopidorus fasciatus* (A: male, upperside. B: *ditto*, underside. C: female, upperside. D: *ditto*, underside). E-H. *Neochalcusia remota* (E: male, upperside. F: *ditto*, underside. G: mature larva on *Symplocos chinensis* (photo: K. Nishihara). H: a newly emerged male adult).

apical part with a small tooth, medial part slightly swelling, cornutus absent.

Female genitalia. Apophyses anteriores short, apophyses posteriores slender, extending to the 7th tergum. Bursa copulatrix with corpus bursae oblique, reaching the hind margin of the 6th segment, appendix bursae absent, paired signa present, lunate, ductus bursae slender,

antrum sclerotized. Ductus seminalis branching near corpus bursae. Pseudobursa present, larger than corpus bursae. Ductus spiralis and lagena present.

Diagnosis. Distinguished from other chalcosiine genera by having paired signa in female genitalia, male 8th sternite with pointed lateral arms and antennae with elongated scales on each segments.

Distribution and Diversity. Only one species known from eastern Palaearctic Asia.

Pseudopidorus fasciatus (Felder & Felder, 1862), **comb. nov.** (Figs 1: A-D, 4 & 12)

Aglaope fasciata Felder & Felder, 1862, *Wien. ent. Monatschr.* **6**: 32. Holotype, ♀, China: Ningpo (BMNH); Leech, 1898, *Trans. ent. Soc. Lond.* **1898**: 325.

Eterusia euchromioides Walker, 1864, *List Specimens lepid. Insects Colln Br. Mus.* **31**: 120. Holotype, ♂, N. China, ex Furtune Collection (BMNH) [examined].

Laurion euchromioides: Kirby, 1892, *Syn. Cat. Lepid. Heterocera* **1**: 53.

Pidorus euchromioides [sic]: Leech, 1898, *Trans. ent. Soc. Lond.* **1898**: 339 (misspl.).

Pidorus euchromioides: Jordan, 1907a, in Seitz, *Gross-Schmett. Erde* **2**: 11, pl. 2, row c; Hering, 1922, *Arch. Naturg.* **88** (A) (11): 65; Matsumura, 1931, *6,000 Illust. Insects Japan-Empire*: 991.

Adult. Length of forewing: ♂, 13 mm, ♀, 11 mm. Antennal length 8.1 mm in male, 8.0 mm in female; flagellar segments 60, 0.7–0.8 mm in width in male, about 90, 0.3–0.35 mm in female. Forewings black with light yellow bands and hindwings with basal yellow patch, female smaller with similar wing marking to male.

Immature stages. Unknown. The larva is suspected to feed on Symplocaceae.

Geographical distribution. Korea, and E. and NE China. The erroneous record from Japan in Bryk (1936) was probably cited from Matsumura (1931) by mis-understanding of the territorial range of Japanese-Empire before the 1950s, which included Taiwan, Korea and many SE. Asian Islands.

Habitat. Unknown.

Biology. In China the adult occurs in June (Wang, 1981).

Phylogenetic accounts

Material and methods

A preliminary phylogenetic analysis was conducted in an attempt to elucidate the relationships between the new genera and other involved genera, and especially to prove that placing the two species either with *Chalcosia* or *Pidorus* Walker, 1854 would not produce a monophyletic group. In the analysis, the genera *Aglaope* Latreille, 1809, *Eterusia* and *Pidorus* were selected as out-groups because they share several characters of the studied group. *Chalcosia zehma* (see Barlow, 1982, Jordan, 1908), a distinct sexually-dimorphic species from SE. Asia, was introduced in the analysis to test if it is monophyletic with *Chalcosia* and if the wing colour pattern is convergent with *Pidorus* and the two new genera. To simplify the elements of the so-called *Chalcosia* genus-complex, the *Chalcosia-syfanica* species-groups were examined as well. *Milleria* was chosen for its taxonomic affinity with the *C.-pectinicornis* species-group. Whenever possible, the type species of the above genera were used. When insufficient material was available for the type species, closely related species in the same genus were introduced. The type species of each genus is shown in bold.

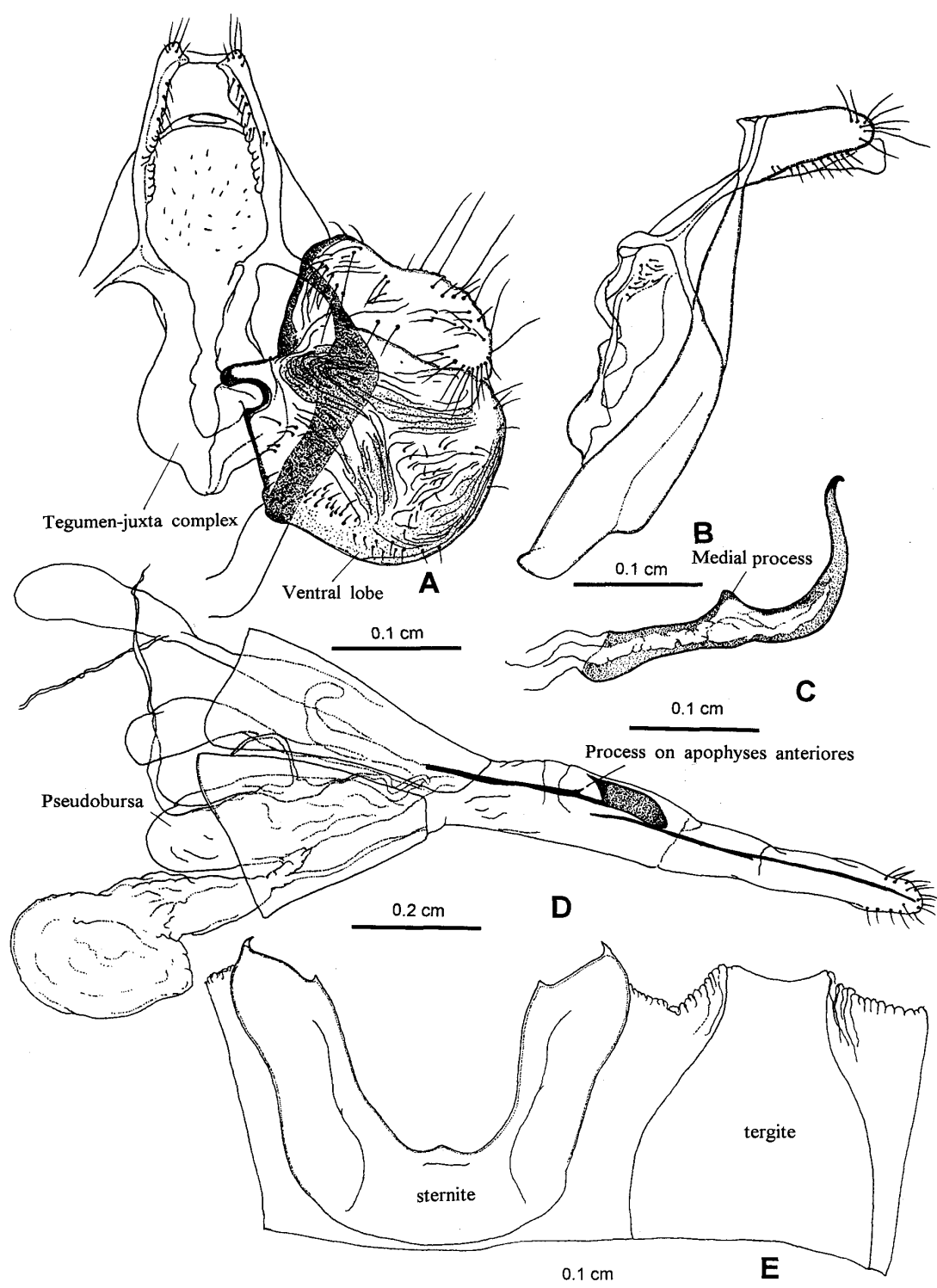


Fig. 2. Genitalia of *Neochalcusia remota*. A. Male genitalia, ventral view with left valva and aedeagus omitted. B. Ditto, lateral view with valvae omitted. C. Aedeagus. D. Female genitalia. E. The 8th abdominal segment of male.

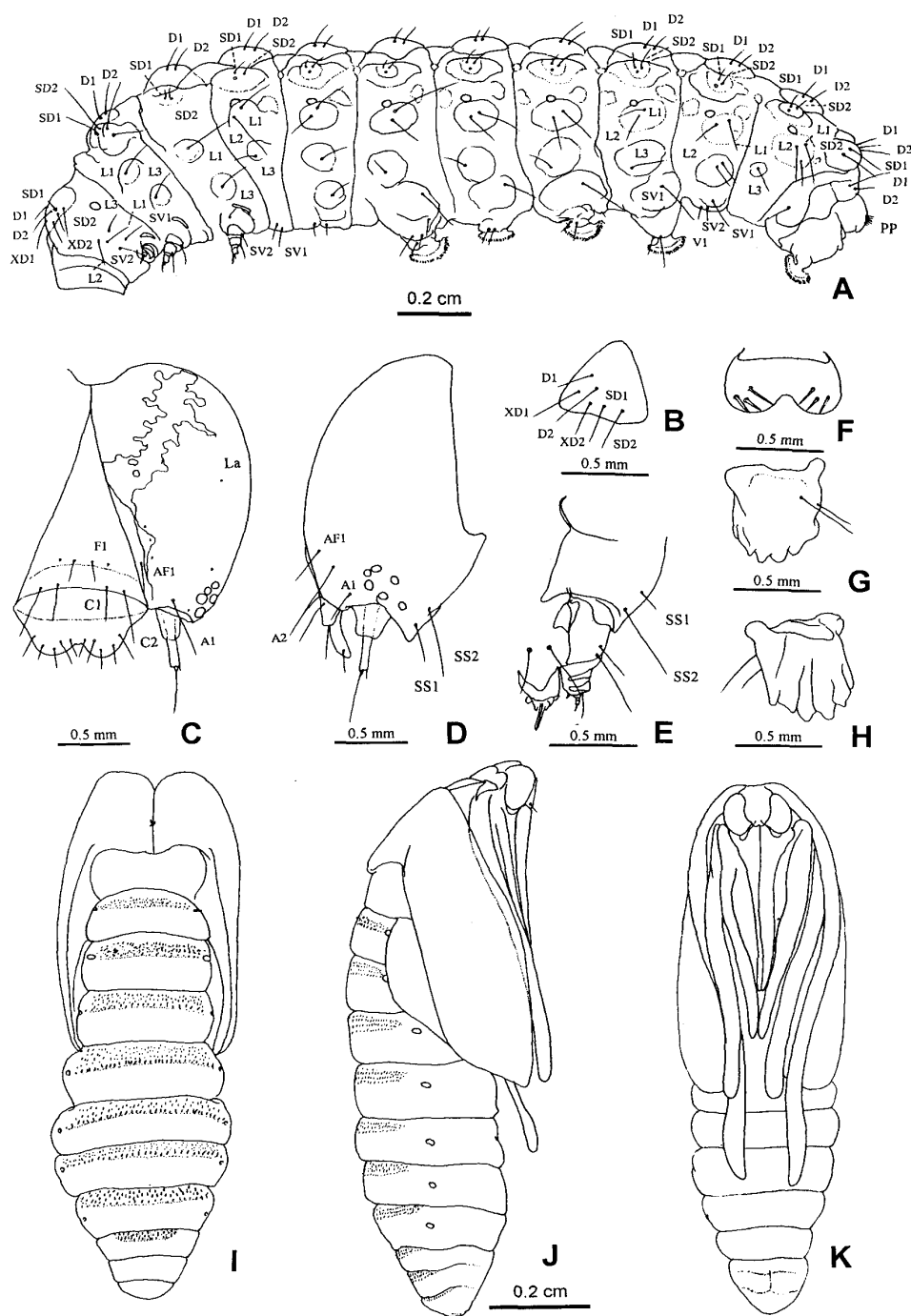


Fig. 3. Immature morphology of *Neochalcosia remota*. A. Chaetotaxy of mature larva. B. Prothoracic shield. C. Cranial chaetotaxy, frontal view. D. *Ditto*, lateral view. E. Right part of hypopharyngeal complex, ventral view. F. Labrum, rear view. G. Mandible, left front. H. *Ditto*, left rear. I. Pupal case, dorsal view without cranial and leg cases. J. *Ditto*, lateral view. K. *Ditto*, ventral view.

Aglaope: *A. infausta* (Linnaeus, 1767) (1 ♂ 1 ♀, S. Europe, SHYC)

Chalcosia: *C. pectinicornis* species-group: *C. pectinicornis* (Linnaeus, 1758) (1 ♂ 1 ♀, China, BMNH); *C. auxo* (Linnaeus, 1767) (1 ♂ 1 ♀, Nepal, HUFA); *C. diana*

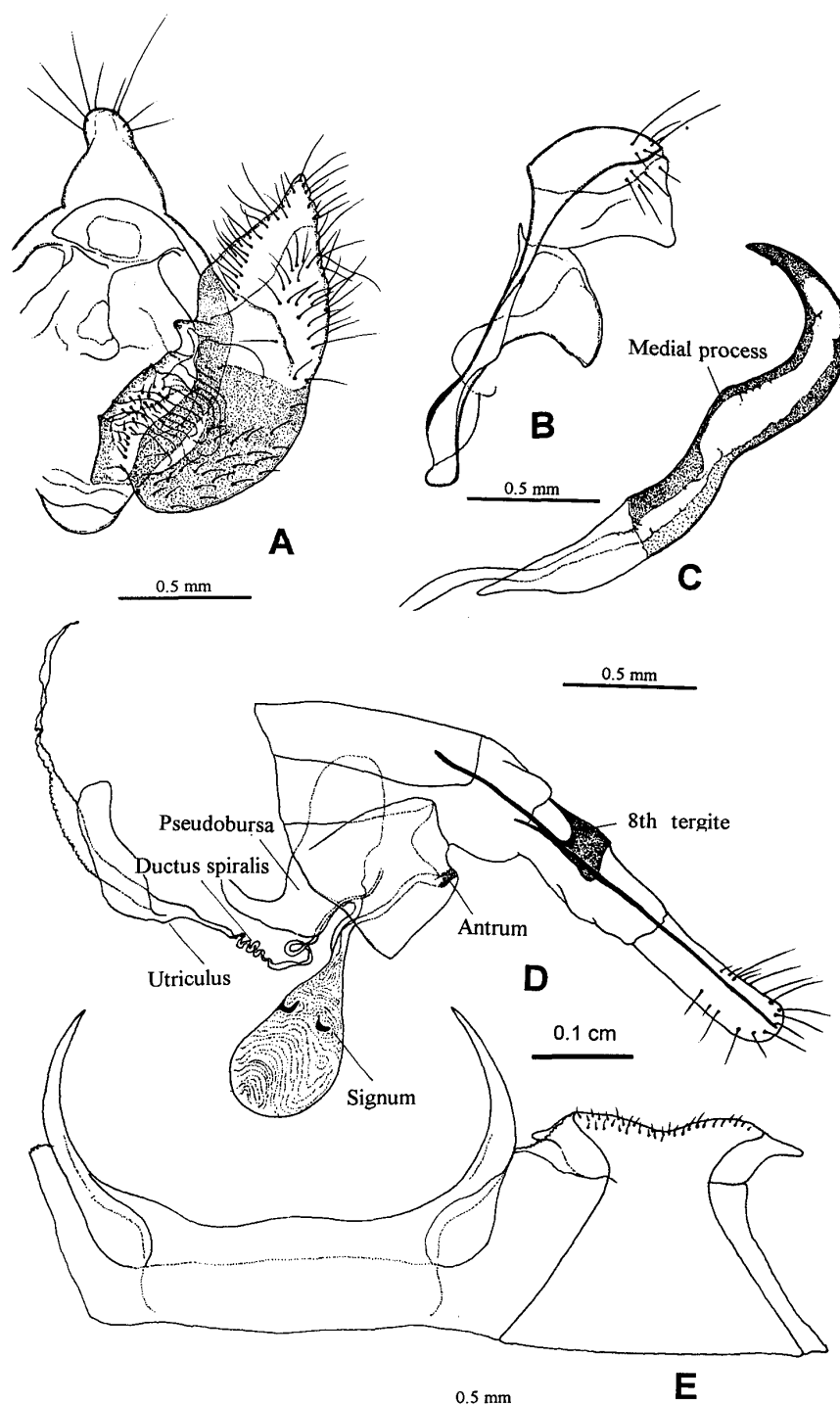


Fig. 4. Genitalia of *Pseudopidorus fasciatus*. A. Male genitalia, ventral view with left valva and aedeagus omitted. B. *Ditto*, lateral view with valvae omitted. C. Aedeagus. D. Female genitalia. E. The 8th abdominal segment of male.

Butler, 1877 (1 ♂ 1 ♀, Taiwan, SHYC); "*Chalcosia*" *zehma* Herrich-Schäffer, 1853 (1 ♂, Malaysia, SHYC; 1 ♀, Borneo, RNHL); "*Chalcosia*"-*syfanica* species-group: *Chalcosia syfanica* Oberthür, 1894 (1 ♂, China, BMNH); *C. thibetana* Oberthür, 1894

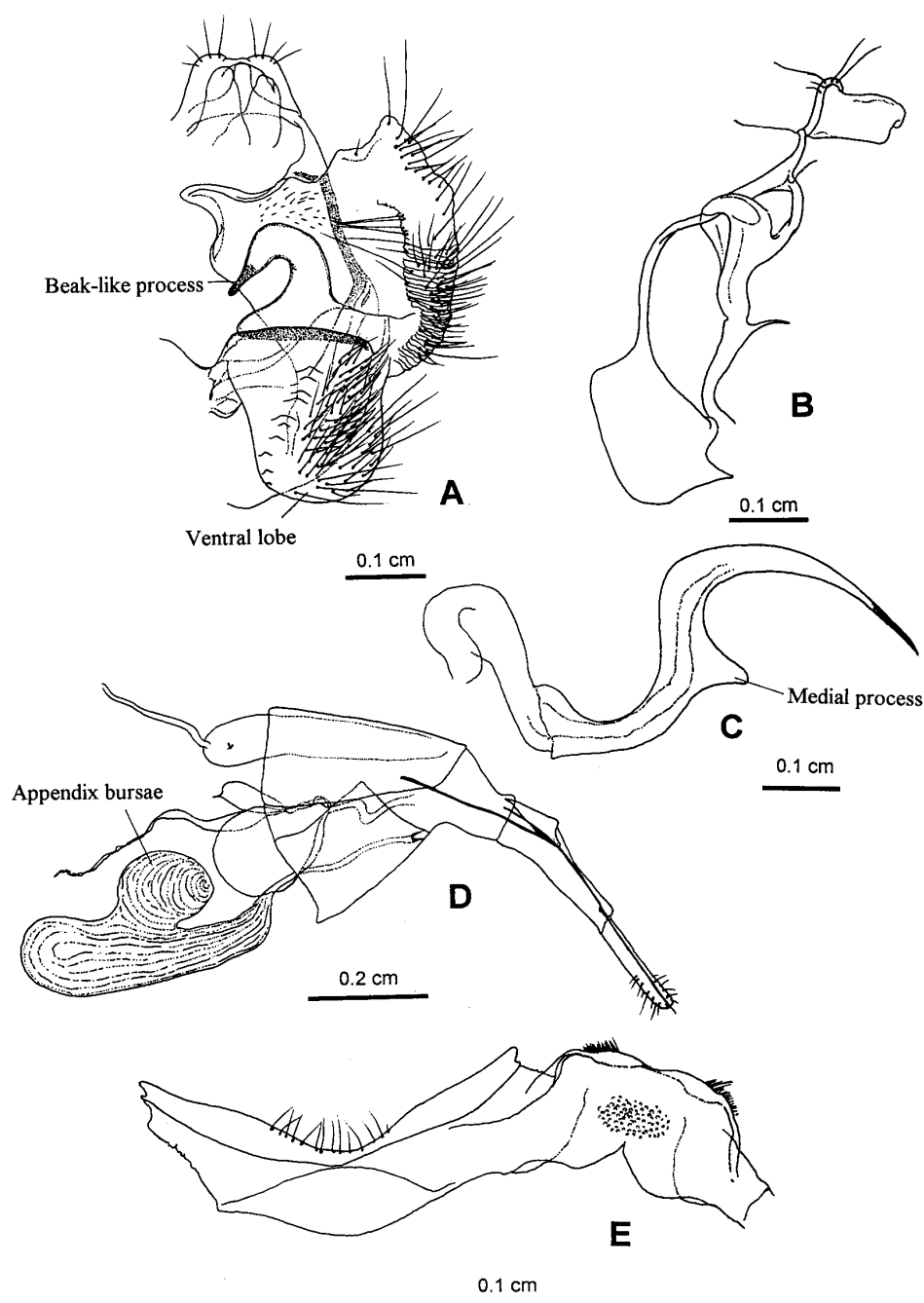


Fig. 5. Genitalia of *Chalcusia pectinicornis*. A. Male genitalia, ventral view with left valva and aedeagus omitted. B. *Ditto*, lateral view with valvae omitted. C. Aedeagus. D. Female genitalia. E. The 8th abdominal segment of male.

(1 ♂, China, BMNH); *C. alpheraki* Leech, 1898 (3 ♂, China, SHYC).

Eterusia: *E. taiwana* Wileman (1 ♂ 1 ♀, Taiwan, SHYC), *E. aedea formosana* Jordan (1 ♂ 1 ♀, Taiwan, SHYC).

Milleria: *M. adalifa* (Doubleday, 1847) (1 ♂ 1 ♀, India, BMNH); *M. lingnami* Mell, 1922 (1 ♂ 1 ♀, China, BMNH).

Neochalcusia: *N. remota* (Walker) (3 ♂ 3 ♀, Japan, SHYC).

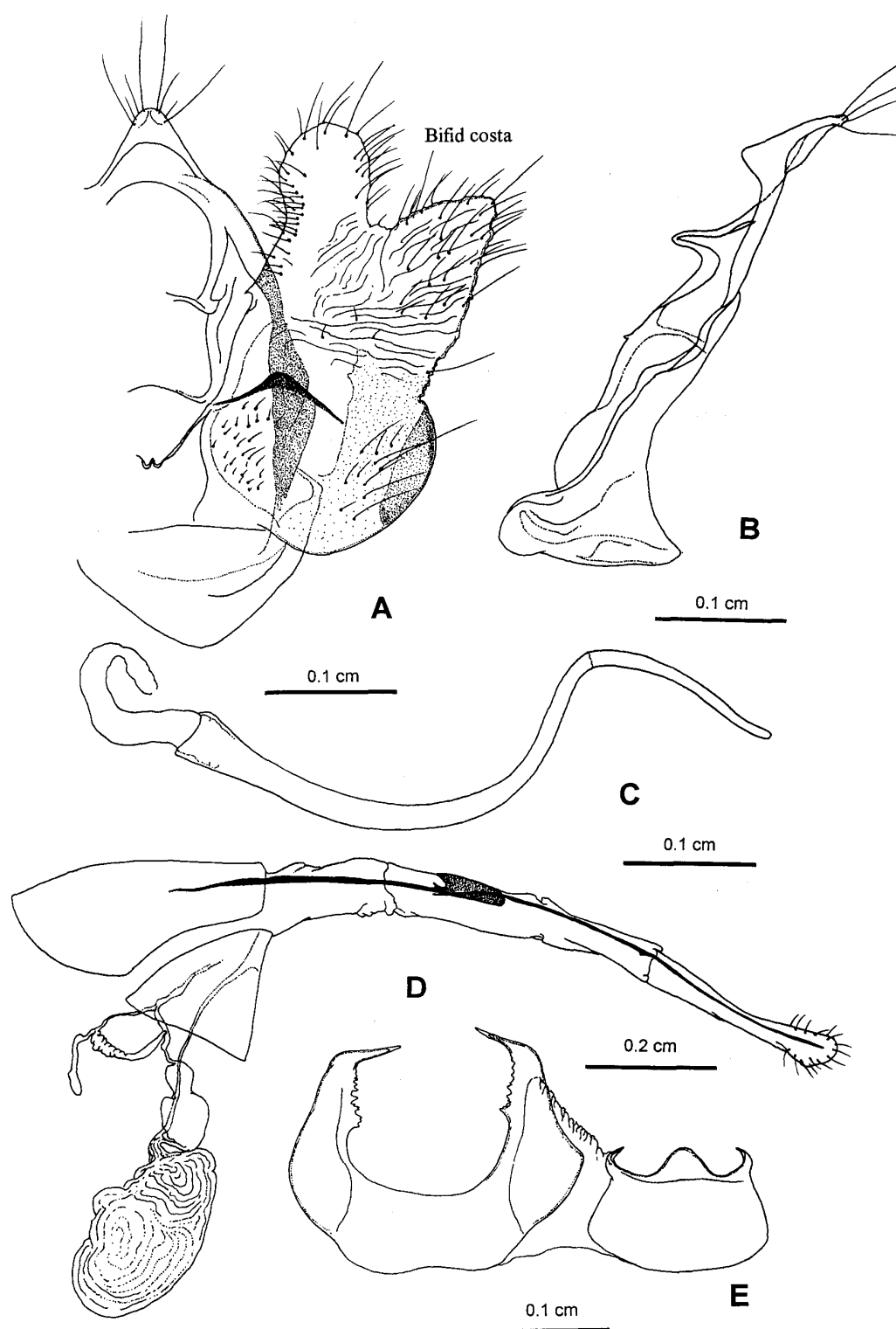


Fig. 6. Genitalia of *Chalcosia zehma*. A. Male genitalia, ventral view with left valva and aedeagus omitted. B. *Ditto*, lateral view with valvae omitted. C. Aedeagus. D. Female genitalia. E. The 8th abdominal segment of male.

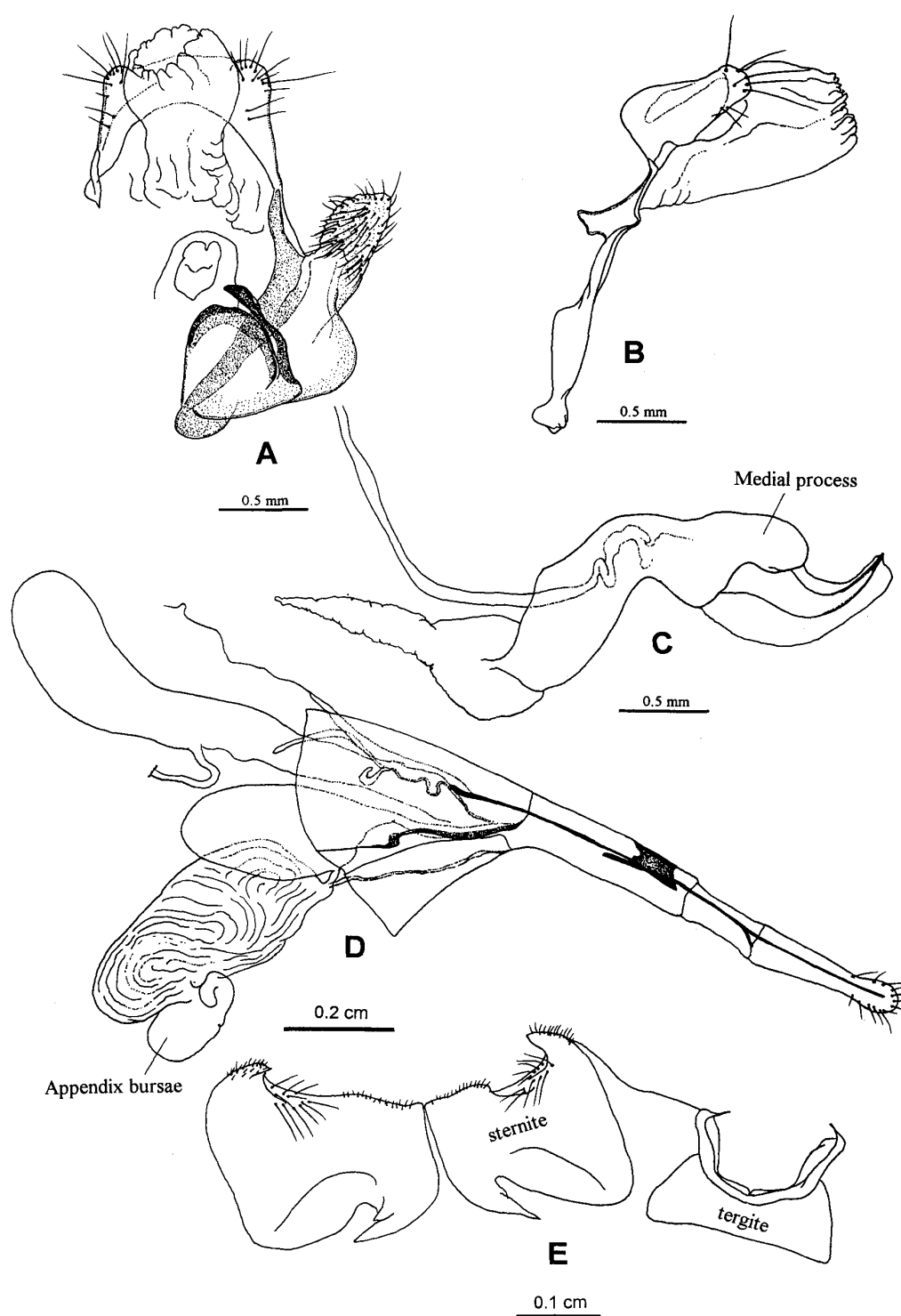


Fig. 7. Genitalia of *Eterusia aedea formosana*. A. Male genitalia, ventral view with left valva and aedeagus omitted. B. Ditto, lateral view with valvae omitted. C. Aedeagus. D. Female genitalia. E. The 8th abdominal segment of male.

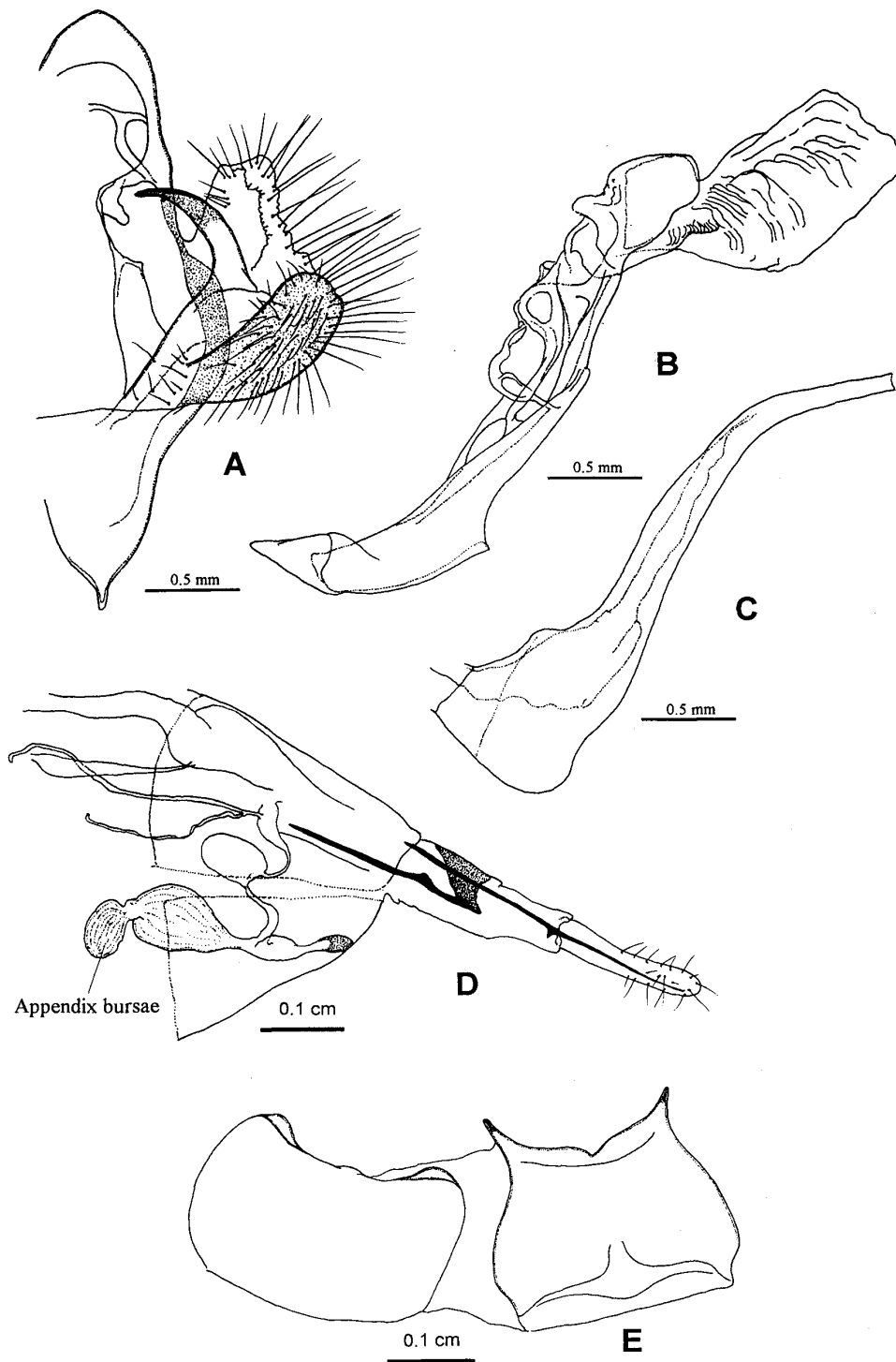


Fig. 8. Genitalia of *Pidorus atratus*. A. Male genitalia, ventral view with left valva and aedeagus omitted. B. *Ditto*, lateral view with valvae omitted. C. Aedeagus. D. Female genitalia. E. The 8th abdominal segment of male.

Pidorus : *P. glaucopis* (Drury) (2 ♂, Nepal) ; *P. atratus* Butler (2 ♂ 2 ♀, Taiwan).

Pseudopidorus : *Ps. fasciata* (Felder) (2 ♂ 1 ♀, Korea, BMNH).

The cladistic method used in the present paper follows the traditional Hennigian approach,

which has been preferred to numerical analyses based on computer programs seeking for parsimonious trees. We discussed the character states, variations and distribution mainly by out-group comparisons, however, the characters did not receive codes because only a small part of the taxa were used in this study, and some information about them was still fragmentary and insufficient to define the transformation series.

Apomorphies of the lineages in the proposed phylogeny

The subfamily Chalcosiinae

Leech (1898) placed *Pseudopidorus fasciatus* (as *Aglaope fasciata*) in the Zygaeninae because the genus *Aglaope* was lumped with the procridine genus *Procris* by earlier authors. The basal root of the proposed phylogeny contains 3 synapomorphies of Chalcosiinae recognized by Tarmann (1992).

1. Male with specialized coremata consisting of a fold on the second abdominal pleurite and an S-shaped bundle of bristles inserted at the margin of the inner angle of the hindwing.
2. Female lacking a pair of accessory glands close to the coporus, which is present in the subfamilies Zygaeninae and Procridinae.
3. Larvae with a specialized chemical defense system, which is different from that in Zygaeninae, and not present in Procridinae.

The tribe Aglaopini

The taxonomic status of this tribe sensu Alberti (1954) will be discussed in a separate paper. This lineage carries several autapomorphies not present in Chalcosiini sensu Alberti (1954).

4. Proboscis greatly reduced.
5. Scales filiform.
6. Chemical secretion openings in mature larva rudimentary.
7. Male genitalia with valva developed, 8th abdominal segment not specialized.
8. Female genitalia without pseudobursae.

The tribe Chalcosiini s. l.

According to my preliminary and unpublished result, the tribe Chalcosiini sensu Alberti (1954) does not clearly constitute a monophyletic group. The following four traits are reliable autapomorphies for Chalcosiini s. l. and they are given here tentatively to define both out-groups and the studied groups in the tribe.

9. Scales with undulate, or corrugated margin.
10. Pseudobursa of female genitalia present.
11. Valva rather reduced compared with Agalopini, Cyclosiini and Aglaopini.
12. Eighth tergite and sternite of male modified into valva-like structures.

Pidorus

Pidorus is distinct from other genera of Chalcosiini by having the following autapomorphies (Fig. 8).

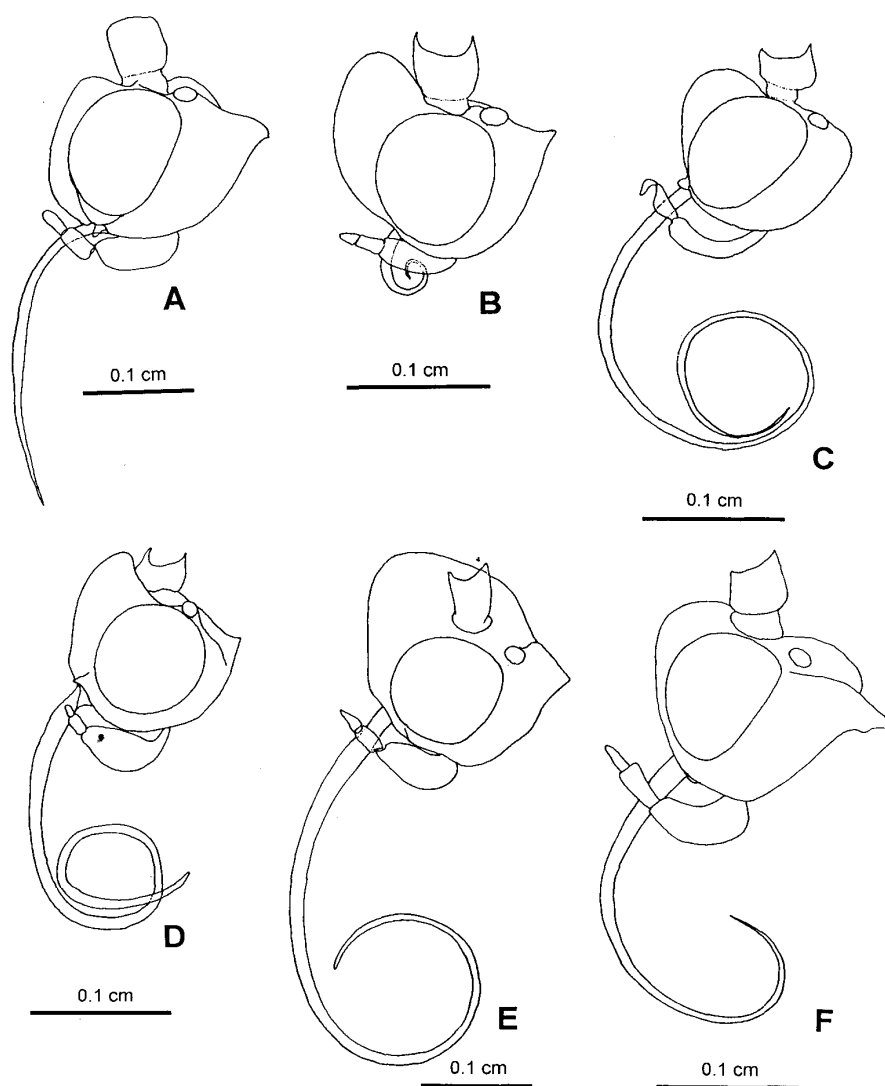


Fig. 9. Head structures. A. *Neochalcusia remota*. B. *Pseudopidorus fasciatus*. C. *Chalcusia diana*. D. *Eterusia aedeae formosana*. E. *Soritia pulchella strandi*. F. *Pidorus atratus*.

13. Aedeagus stout. The shape of the aedeagus of the tribe is variable but constant in each lineage. The aedeagus shape of *Pidorus* may represent the primitive state without modification and medial swelling by comparison with that of Aglaopini and Agalopini.
14. A long, strongly sclerotized process present on distal part of valva.
15. The 8th abdominal segment less modified.
16. Uncus nearly glabrous or sparsely setose.

The *Eterusia*+*Chalcusia* genus-complex

This clade is grouped together by the following characters.

17. Uncus setose dorsally.
18. Proximal part of aedeagus curved and acute. The aedeagus shape of *Eterusia* is stout with rather acute terminal and great post-medial swellings. This character is somewhat similar to that of the *Chalcusia* genus-complex, but we did not determine the polarity

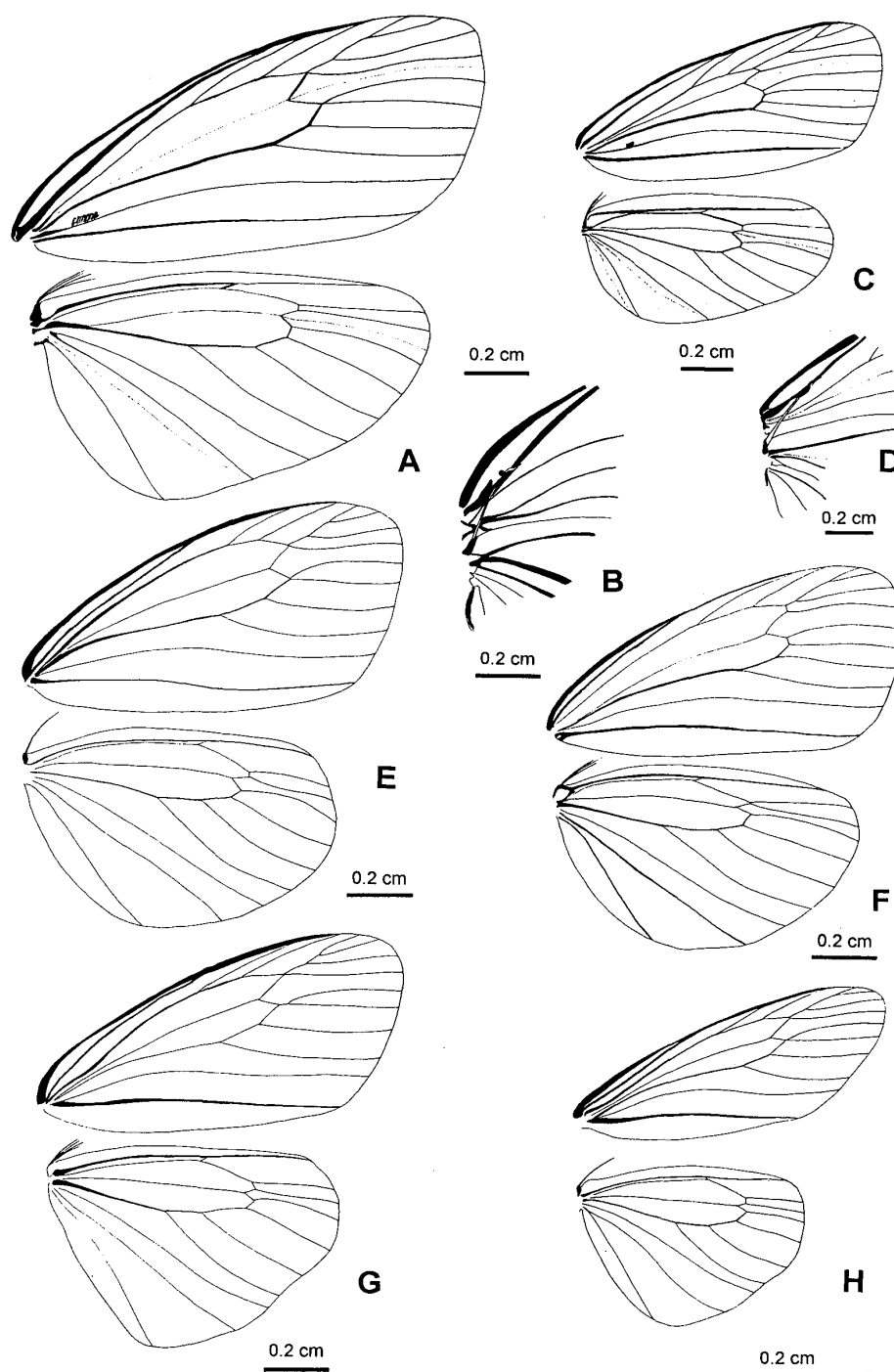


Fig. 10. Venation. A. *Neochalcusia remota*, female. B. *Ditto*, male, magnification of wing coupling mechanism. C. *Pseudopidorus fasciatus*, female. D. *Ditto*, male, magnification of wing coupling mechanism. E. *Chalcusia thaivana*, male. F. *Pidorus atratus*, female. G. *Chalcusia zehma*, female. H. *Ditto*, male.

of these two "states" of aedeagus shape. The other shape of aedeagus in Chalcosiini is present in the lineage *Amesia*+*Erasmia*+*Erasmiphlebohecta*+*Chalcophaedra* group, where the aedeagus is rather strong and stout with phallobase curved.

The *Chalcosia* genus-complex

At the moment, it is not clear how many genera and species are involved in this complex. In the present analysis, only the materials available were used. The “*Chalcosia*”-*syfanica* species-group from W. China was excluded from the discussion because the male genitalia is too distinct from most named chalcosiine genera by having a bifid uncus, developed gnathos and a harpe on the valva. The following three traits are proposed as synapomorphies of the studied groups.

19. Costa of valva not reduced or rudimentary.
20. Aedeagus slender with apex acute.
21. Appendix bursae of corpus bursae absent (only present in *Chalcosia* s. str.).

“*Chalcosia*” *zehma*

This species was brought into the analysis because it possesses a similar wing pattern to the two new genera but has distinct genitalia structures. It appears that the forewing-white-band style in Chalcosiini is a ground plan in every lineage and is not suitable to be a synapomorphy (Fig. 6).

22. Valva with costal margin bifid, distal process not present, only one ridge on ventral lobe.
23. Terminal of aedeagus slender, curved downwards, no process present medially. This distinct character state is only known from this species at the present : whether the fairly slender aedeagus represents a state or a secondary loss of the medial process is still uncertain.
24. Eighth tergite with a posterior process medially and arched arms laterally, sternite arms strongly sclerotized, with interior margin dentate.

The clade (*Neochalcosia* + *Pseudopidorus*) + (*Chalcosia* s. str. + *Milleria*)

This clade is defined weakly and the monophyly is still doubtful. The hypothetical phylogeny of the *Chalcosia* genus-complex should be revised by an overall examination of some important genera such as *Eusphalera* Jordan, 1907 (type species: *Heterusia regina* Rothschild & Jordan, 1903) and *Pseudonyctemera* Piepers & Snellen, 1903 (type species: *Leptosoma marginale* Snellen van Vollenhoven, 1863), which may provide informative character states for determination of transformation series.

25. Valva with process on inner margin, ventral lobe with numerous grooves on the surface.

Monophyly of *Neochalcosia* + *Pseudopidorus*

These two genera are grouped together with the following three characters. The larval morphology of *Neochalcosia* was not included in the analysis because that of *Pseudopidorus* is not available at present (Figs 2 & 4).

26. Valva with distal process short, not beak-like ; ventral lobe strongly sclerotized with crinkly grooves.
27. Interior extension of tegumen slender, forming a complex with juxta.
28. Terminal part of aedeagus upturned, medial part slightly produced.

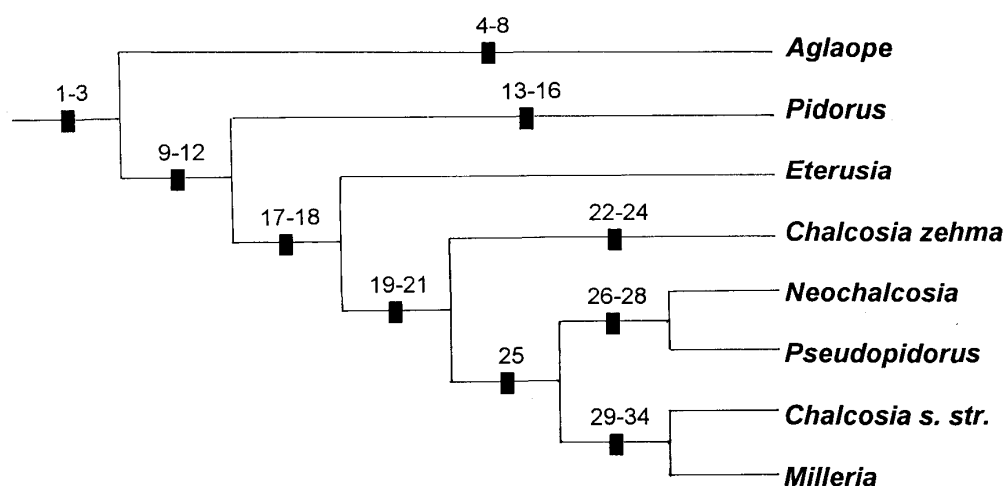


Fig. 11. Hypothetical phylogeny of the taxa involved in the present study.

Monophyly of *Chalcosia s. str.* + *Milleria*

The taxonomic definition of *Chalcosia s. str.* (Fig. 5) in the present paper is confined to *C. pectinicornis* and its allied species, by excluding some sexually dimorphic species and the *C. syfanica* species-group. The taxonomic boundary between *Chalcosia* and *Milleria* will be discussed in a separate paper in the near future. The *Symplocos*-feeding behaviour is shared by both genera. This ecological character may also be present in the *Neochalcosia* + *Pseudopidorus* clade but it is retained here until the hostplant and immatures of *Pseudopidorus* are discovered. The polyphagous *Eterusia* is also reported from *Symplocos* (Nishihara, 1992, 1995) but it is not clear if such similarity of hostplant selection is a ground-plan character of the *Eterusia* + *Chalcosia* genus-complex or derived independently in each lineage.

29. Uncus rather rudimentary and slender laterally.
30. Interior extension of tergum flattened.
31. Valva with margin setose and crinkly, distal process beak-like, ventral lobe of valva flattened caudo-cephalid with several ridges posteriorly.
32. Sacculus broad, somewhat rectangular laterally.
33. Aedeagus curved downwards with a prominent medial process beneath.
34. Eighth tergite slightly emarginate medially and bullate beneath; sternite with posterior margin strongly sclerotized and slightly setose medially.

Some apomorphies that need further investigation

The following traits are potential autapomorphies of the major lineages of Chalcosiini. However, at present we tend to regard these traits for various reasons as less reliable than those enumerated so far, and many of them still have to be checked within several taxa. In the following brief survey, apomorphies 35–37 pertain to the larvae and 38–44 to the imago.

35. L3 verrucae present. This apomorphy is shared by *Chalcosia s. str.*, *Milleria* and *Neochalcosia* but is not present in *Eterusia*, *Soritia* (type species: *Chalcosia leptalina* Kollar, [1844] = *Chalcosia pulchella* Kollar, [1844]) and *Pidorus*. The character is not included in the phylogeny until the larvae of other *Chalcosia* genus-complex are discovered and the chaetotaxy is examined.

36. Both SD1 and SD2 verrucae bisetose (Fig. 3). The trait is present in *Neochalcusia*, but it is unknown if *Pseudopidorus* has the same character state.
37. Number of setae on rear view of labrum. The character has not been investigated very well in each group due to rarity of larvae. In *Eterusia*, *Soritia* and *Pidorus*, the number is 3. In *Neochalcusia* the number is also 3, but 4 in *Chalcusia s. str.* and *Milleria*. It is not clear whether the number could be a character transformation series.
38. Frontoclypeus elevated (Fig. 9). The character is present inconstantly in various groups of Chalcosiinae. Whether all the elevated states are homologous and how to code the character need further consideration.
39. Number of female frenula (Fig. 10). This trait varies in different groups. In general, most chalcosiine genera examined have 4 bristles in number, but in *Pseudopidorus* and *Chalcusia s. str.* the number is 3, and is 5 in *Pidorus*. The trisetose frenulum is probably the primitive state, while tetrasetose and pentasetose states may be derived secondarily.
40. Medial bands on forewings. This trait occurs in various groups of Chalcosiini in different types. The band type extending straight from costal margin to submarginal innerside is shared by most genera of the *Chalcusia* genus-complex, however, the character is not suggested for inclusion in the phylogeny in order to prevent a homoplastic result.
41. Ventral lobe of valva with transverse ridges. This character state is also shared by *Histia* Hübner, [1820] (type species: *Zygaena flabellicornis* Fabricius, 1775): however the genus was not brought into the analysis because the phylogeny here proposed is strengthened if *Neochalcusia* and *Pseudopidorus* form a monophyly with *Chalcusia s. str.*
42. Process on apophyses anteriores. This character is only present in *Neochalcusia* (Fig. 2), *Chalcusia zehma* (Fig. 6) and *Milleria* in a different direction. The process of both *C. zehma* and *Milleria* extends anteriorly but that of *Neochalcusia* is produced posteriorly.
43. Appendix bursae of corpus bursae present. This character may be present independently and inconstantly in different lineages of Chalcosiini. The *Eterusia* genus-group (Fig. 7) has the appendix bursae located medially or antero-medially on the corpus bursae, while in *Pidorus* (Fig. 8) the appendix bursae is located on the anterior apex of the corpus bursae. In the *Chalcusia-pectinicornis* species-group (Fig. 5), this character is also present but it might be secondary, based on comparison with other character combinations.
44. Sexual dimorphism. An interesting sexual dimorphism is present in *Milleria* and *Chalcusia zehma* (Fig. 10 G & H). This character, however, is not included into the phylogeny because some other chalcosiine genera such as *Psaphis* Walker, 1854 (type species: *Psaphis camadeva* Walker, 1854 = *Gynautocera camadeva* Doubleday, 1847), *Soritia* Walker, 1854, *Prosopandrophila* Hering, 1922 (type species: *Gynautocera distincta* Guérin-Méneville, 1843) and *Hemiscia* Jordan, 1908 (type species: *Herpa meeki* Rothschild, 1896) also bear very distinct sexual differences. Such character is not only influenced genetically but also by selection pressures from natural enemies, so the sexual dimorphism is very likely caused by parallel evolution.

Comments on taxonomy of the *Chalcusia* genus-complex

As discussed in the above sections, the *Chalcusia* genus-complex is rather chaotic with many problems in phylogeny and specific taxonomy. The new genera *Neochalcusia* and

Pseudopidorus are monophyletic and very close in wing pattern, but we still tend to create two monotypic genera for them to emphasize the significance of the paired signa of *Pseudopidorus*. The *C.-zehma* clade is not proposed as a new genus at present because the infraspecific taxonomy of this rare species has not been investigated. Besides, the relationship between the species and its potential relative "*Pidorus*" *splendens* Jordan, 1907 has not been clarified. The *C.-syfanica* species-group is obviously not monophyletic with the genera of Chalcosiini but has not been elevated to generic level because its phylogenetic relationships and taxonomic position within the subfamily Chalcosiinae are not clear at the moment. As to the taxonomy of *Chalcosia* s. str. and *Milleria*, we still need more time to examine the type specimens of each named taxon and determine the variability of and subspecific relationships between taxa. The proposed hypothetical phylogeny is shown in Fig. 11.

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摘 要

東南アジアのマダラガ亜科の2新属の記載 (顔聖紘・楊平世)

成虫および幼虫の形質に基づき、東南アジアのマダラガの2新属を記載し、これらの系統関係を議論した。新属はシロシタホタルに対する *Neochalcusia* (模式種は *Eterusia remota* Walker, 1854) とヒメホタルガに対する *Pseudopirorus* (模式種は *Aglaope fasciata* Felder & Felder, 1862)。前者はこれまで *Chalcusia* 属の一員として、後者は *Pidorus* 属の一員として扱われていた。

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